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Subject: ACI Response to NIST WTC Recommendations
From: Daniel.Falconer@concrete.org

Sir/Madam,

In response to The Federal Building and Fire Safety Investigation of the World Trade Center Disaster, *Final Report of the National Construction Safety Team on the Collapses of the World Trade Center Tower*, ACI submits the following responses for Sessions 5 (Structural Fire Response and Collapse Analysis) and 6 (Analysis of Active Fire Protection Systems, and Building & Fire Codes and Practices).

Submitted by:

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The American Concrete Institute (ACI) is a non-profit technical and educational society, dedicated to producing reliable consensus information on concrete materials and the design, behavior, construction, and repair of concrete structures. ACI commends NIST for developing this report and recommendations, and is pleased to work with NIST and others in addressing those recommendations.

General Comment: The NIST recommendations related to building design, construction practices, standards, and codes are broad in nature and will, therefore, need to be addressed by many organizations. Meeting the challenges that NIST has identified will require coordination and harmonization among various professional and technical organizations, such as ACI, ASCE, AISC, ASTM, and TMS, as well as support from practitioners and researchers in design and construction. This will likely require the formation of a coordinating body.

The following are specific responses to NIST Recommendations:

Recommendation 1: that (1) progressive collapse should be prevented in buildings through the development and nationwide adoption of consensus standards and code provisions, along with the tools and guidelines needed for their use in practice; and (2) a standard methodology should be developed—supported by analytical design tools and practical design guidance—to reliably predict the potential for complex failures in structural systems subjected to multiple hazards.

Response: Prior to the Murrah Building terrorist attack, the general issue of prevention of reinforced concrete building progressive collapse was addressed in ACI 318. Following that attack, these requirements were strengthened. When specific design criteria for prevention of progressive collapse are developed, ACI Committee 318 will develop appropriate requirements for reinforced concrete buildings.

Recommendation 3: that an appropriate criterion should be developed and implemented to enhance the performance of tall buildings by limiting how much they sway under lateral load design conditions (e.g., winds and earthquakes).

Response: ACI will ask the members of Committee 375, "Performance-Based Design of Concrete

Buildings for Wind Loads,” to review and address this issue.

Recommendation 5: that the technical basis for the century-old standard for fire resistance testing of components, assemblies, and systems should be improved through a national effort. Necessary guidance also should be developed for extrapolating the results of tested assemblies to prototypical building systems.

Response: ACI’s fire design recommendations and requirements rely on the results from many hundreds of fire tests, all based on the ASTM E 119 test. Substantial changes to this ASTM standard may result in the need for a fire testing program of substantial proportions. Because of a lack of existing, large scale fire testing facilities, a fire test program may require a major industry-government initiative to design and construct such facilities.

Recommendation 7: the nationwide adoption and use of the “structural frame” approach to fire resistance ratings.

Response: ACI will ask Committee 216 “Fire Resistance and Fire Protection of Structures” and Committee 318 “Structural Concrete Building Code” to review and address this issue.

Recommendation 8: that the fire resistance of structures should be enhanced by requiring a performance objective that uncontrolled building fires result in burnout without local or global collapse.

Response: ACI agrees with this goal, but research to develop reliable mathematical models is needed before implementation. Satisfying NIST Recommendation 9 is a prerequisite to satisfying this recommendation.

Recommendation 9: the development of: (1) performance-based standards and code provisions, as an alternative to current prescriptive design methods, to enable the design and retrofit of structures to resist real building fire conditions, including their ability to achieve the performance objective of burnout without structural or local floor collapse; and (2) the tools, guidelines, and test methods necessary to evaluate the fire performance of the structure as a whole system.

Response: ACI agrees with this goal. However, the ability to characterize actual building fires and their thermal impact on the elastic and inelastic behavior of concrete structures is not currently available. Development of reliable models is needed before this approach can be incorporated in building codes.

Recommendation 11: that the performance and suitability of advanced structural steel, reinforced and prestressed concrete, and other high-performance material systems should be evaluated for use under conditions expected in building fires.

Response: ACI agrees with this goal.

Recommendation 29: that continuing education curricula should be developed and programs should be implemented for training fire protection engineers and architects in structural engineering principles and design, and training structural engineers, architects, and fire protection engineers in modern fire protection principles and technologies, including fire-resistance design of structures.

Response: ACI agrees that the development of the proposed curricula would be of benefit to the industry. It is not clear, however, that we have an adequate understanding of the response of building structures under fire load.

Recommendation 30: that academic, professional short-course, and web based training materials in the use of computational fire dynamics and thermo-structural analysis tools should be developed and delivered to strengthen the base of available technical capabilities and human resources.

Response: ACI agrees with these educational goals.

Final Comment: ACI's Executive Committee affirms that NIST's recommendations in this area are valuable and worthwhile, and has created a Task Group to assure high-level cooperation.

Recommendations 3 and 7 can be reviewed and addressed in the short-term, but addressing recommendations 1, 5, 8, 9, 11, 29, and 30 will depend on an increase in the current state of knowledge.

The successful implementation of these recommendations will require research along with a funding source and oversight mechanism.